

Effect of Population Density on the Results of the Study of Water Supplies in Five California Counties

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Two previous studies (1969-1971 and 1969-1974) examined the association between cancer incidence and chrysotile asbestos ingested through drinking water in the San Francisco-Oakland Standard Metropolitan Statistical Area (SMSA). Population density, an important covariable in the association between cancer and environmental agents, was not included in the analyses of these studies. The present work determines the effect of this covariable on the results of the second San Francisco-Oakland SMSA study. The original and reanalyzed results are compared to reassess the association between cancer and asbestos. The only change in the regression procedures of the original studies was the addition of population density as an independent variable in the reanalysis. The results of the reanalysis showed that population density had little effect on the results of the second study. Slightly more significance was found for asbestos regression coefficients in the reanalysis, including population density, than in the original analysis. These regression coefficients for asbestos indicated a positive association between ingested chrysotile asbestos and some cancer body sites. The conclusion of the reanalysis was that population density was distributed across the San Francisco-Oakland SMSA in such a way that it had little effect on the observation of an association between ingested asbestos and cancer.

Introduction

The association between ingested chrysotile asbestos and cancer was investigated in a project entitled "Asbestos in Domestic Water Supplies in Five California Counties," which was sponsored by the U.S. Environmental Protection Agency (U.S. EPA). In that project, standard incidence ratios for cancers of various body sites were analyzed for their associations with ingested asbestos through drinking water while the covariables of socioeconomic status, marital status, and asbestos-related industries were controlled. The study area was the San Francisco-Oakland Standard Metropolitan Statistical Area (SMSA) and the unit of observation was the census tract. Questions have been raised concerning the validity of the results of that work because population density of the SMSA and census tracts were not considered in the analysis. The present work in-

cludes population density in a reanalysis of the data accumulated under the U.S. EPA-Sponsored project.

Two studies emerged from the research on asbestos and cancer in the San Francisco-Oakland SMSA. Cancer incidence between 1969 and 1971 was analyzed in the initial study and has been reported by Kanarek et al. (1). A second study of cancer incidence between 1969 and 1974 was carried out and published by Conforti et al. (2). The present work is a reanalysis of the 6-yr data base (1969-1974) to determine the effect of population density on the observation of an association between ingested asbestos and cancer.

Methodology

Population density data (square kilometers of each 1970 census tract and population figures) were obtained from the Socio-Economic-Environmental Demographic Information System (SEEDIS) of the Computer Science and Mathe-

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matics Department, Lawrence Berkeley Laboratory, University of California, Berkeley (3). The square kilometers for each 1970 census tract were calculated in the SEEDIS system from coordinates of latitude and longitude on the boundaries of the census tracts. Coordinates were used to create triangles within the tracts, and the areas of these triangles were calculated and summed to yield the square kilometers per census tract. The coordinates were obtained from the Dual Inde-

pendent Map Encoding (DIME) file of the 1970 Census of Population and Housing of the Bureau of the Census (4).

Since the reanalysis was made for the 6-yr cancer incidence data (1969–1974) and the midpoint of that study period was January 1, 1972, extrapolated population figures (based on 1960 and 1970 censuses) for January 1, 1972 were used in calculating population density. The extrapolation required identical boundaries between 1960

Table 1. Cancer sites analyzed in asbestos study of San Francisco–Oakland SMSA, incidence, 1969–74.

Site no.	Name	RCE site no. ^a	ICD 8th Rev. site nos. ^b
1	All sites	010–940	
2	All digestive	500–590	150–159
3	Digestive tract	500–549	150–154
4	Esophagus	500–509	150
5	Stomach	510–519	151
6	Small intestine	520–529	152
7	Colon	530–539	153
8	Rectum	540–549	154
9	Digestive-related organs	550–589	155–158
10	Liver	550–551	155
11	Gallbladder	560–569	156
12	Pancreas	570–579	157
13	Retroperitoneum	580–589	158
14	Digestive organ NOS ^c	590	159
15	All respiratory	619–639	161–163
16	Larynx	619	161
17	Trachea, bronchus, lung	620–621	162
18	Pleura	630	163.0
19	Mediastinum	631	163.1
20	Breast	700–709	174
21	Female reproductive	710–759	180–183
22	Cervix uteri	710	180
23	Corpus uteri	720	182.0
24	Ovary	750	183.0
25	Prostate	770	185
26	Urinary	800–810	188–189
27	Kidney	800–804	189
28	Bladder	810	188
29	Brain	930	191
30	Thyroid	940	193
31	Hodgkin's disease	010	201
32	Leukemia	040–049	204–208
33	Lung small cell carcinoma	621 RCE-hist 804	
34	Lung squamous	621 RCE-hist 807	
35	Lung adenocarcinoma NOS ^c	621 RCE-hist 814	

^aManual of Tumor Nomenclature and Coding.

^bEighth Revision International Classification of Diseases, 1968.

^cNot otherwise specified.

Table 2. Number of super tracts in tract groupings by chrysotile asbestos fiber counts of the San Francisco–Oakland SMSA, 1972.

	Chrysotile asbestos fibers/L				Total
	25,000–305,812	310,000–330,000	350,000–19,542,843	20,000,000–36,000,000	
Number of super tracts	92	110	107	101	410

Table 3. Frequency distribution of population density for 427 super tracts of the San Francisco-Oakland SMSA, 1972.

Population/km ²	Frequency	Relative frequency, %	Cumulative frequency, %
0-1000	82	19.2	19.2
1000-2000	37	8.7	27.9
2000-3000	56	13.1	41.0
3000-4000	63	14.8	55.8
4000-5000	48	11.2	67.0
5000-6000	31	7.3	74.3
6000-7000	20	4.7	79.0
7000-8000	9	2.1	81.1
8000-9000	14	3.3	84.4
9000-10000	9	2.1	86.5
10000-11000	8	1.9	88.4
11000-12000	8	1.9	90.3
12000-13000	8	1.9	92.2
13000-14000	3	0.7	92.9
14000-15000	5	1.2	94.1
15000-16000	3	0.7	94.8
16000-17000	1	0.2	95.0
17000-18000	1	0.2	95.2
18000-19000	3	0.7	95.9
19000-20000	2	0.5	96.4
20000-21000	1	0.2	96.6
21000-22000	0	0.0	96.6
22000-23000	2	0.5	97.1
23000-24000	2	0.5	97.6
24000-25000	0	0.0	97.6
25000-26000	3	0.7	98.3
26000-27000	1	0.2	98.5
27000-28000	0	0.0	98.5
28000-29000	2	0.5	99.0
29000-30000	0	0.0	99.0
30000-31000	0	0.0	99.0
31000-32000	0	0.0	99.0
32000-33000	2	0.5	99.5
33000-34000	1	0.2	99.7
34000-35000	0	0.0	99.7
35000-36000	0	0.0	99.7
36000-37000	0	0.0	99.7
37000-38000	1	0.2	99.9
38000-39000	0	0.0	99.9
39000-40000	1	0.2	100.0
427			

and 1970 census tracts. Census tracts in 1960 and 1970 were not in one-to-one correspondence. Census tract groupings (super tracts) were developed that had corresponding geographical boundaries between censuses. In 1970 there were 722 census tracts in the San Francisco-Oakland SMSA. The grouping of census tracts into super tracts yielded 427 super tracts. Square kilometers for each of the 722 census tracts were summed in each of their corresponding super tracts to yield square

kilometers per super tract. Population density was then calculated for each super tract by dividing population by square kilometers to yield population per square kilometer for each super tract.

Standard incidence ratios for 35 body sites of cancer were used as the dependent variables in the analyses. The independent variables were socioeconomic status, marital status, asbestos-related industries, asbestos in drinking water, and population density. Socioeconomic status was

Table 4. Frequency distribution of population density for 199 super tracts of the West Bay Area, 1972.

Population/km ²	Frequency	Relative frequency, %	Cumulative frequency, %
0-1000	35	17.6	17.6
1000-2000	14	7.0	24.6
2000-3000	21	10.6	35.2
3000-4000	24	12.1	47.3
4000-5000	13	6.5	53.8
5000-6000	10	5.0	58.8
6000-7000	5	2.5	61.3
7000-8000	5	2.5	63.8
8000-9000	11	5.5	69.3
9000-10000	6	3.0	72.3
10000-11000	8	4.0	76.3
11000-12000	7	3.5	79.8
12000-13000	7	3.5	83.3
13000-14000	3	1.5	84.8
14000-15000	4	2.0	86.8
15000-16000	3	1.5	88.3
16000-17000	1	0.5	88.8
17000-18000	1	0.5	89.3
18000-19000	3	1.5	90.8
19000-20000	2	1.0	91.8
20000-21000	1	0.5	92.3
21000-22000	0	0.0	92.3
22000-23000	2	1.0	93.3
23000-24000	2	1.0	94.3
24000-25000	0	0.0	94.3
25000-26000	3	1.5	95.8
26000-27000	1	0.5	96.3
27000-28000	0	0.0	96.3
28000-29000	2	1.0	97.3
29000-30000	0	0.0	97.3
30000-31000	0	0.0	97.3
31000-32000	0	0.0	97.3
32000-33000	2	1.0	98.3
33000-34000	1	0.5	98.8
34000-35000	0	0.0	98.8
35000-36000	0	0.0	98.8
36000-37000	0	0.0	98.8
37000-38000	1	0.5	99.3
38000-39000	0	0.0	99.3
39000-40000	1	0.5	100.0
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measured by median family income and mean years of schooling. Marital status was computed as the proportion of unmarried persons in the population. Asbestos-related industries were calculated as the proportion of workers with potential occupational exposure to asbestos in industries such as the construction, electrical, and textile industries. Asbestos was measured as the number of chrysotile fibers per liter of drinking water. These variables were recorded for each super tract of the San Francisco-Oakland SMSA.

Regression analyses were performed including population density. Correlations were calculated between standard incidence ratios of cancer and population density. Descriptive and summary statistics were also computed.

Results

The cancer sites analyzed and their sources are presented in Table 1. All major cancers except skin and bone are included. Some of the cancer

Table 5. Frequency distribution of population density for 228 super tracts of the East Bay Area, 1972.

Population/km ²	Frequency	Relative frequency, %	Cumulative frequency, %
0- 1000	47	20.6	20.6
1000- 2000	23	10.1	30.7
2000- 3000	35	15.4	46.1
3000- 4000	39	17.1	63.2
4000- 5000	35	15.4	78.6
5000- 6000	21	9.2	87.8
6000- 7000	15	6.6	94.4
7000- 8000	4	1.8	96.2
8000- 9000	3	1.3	97.5
9000-10000	3	1.3	98.8
10000-11000	0	0.0	98.8
11000-12000	1	0.4	99.2
12000-13000	1	0.4	99.6
13000-14000	0	0.0	99.6
14000-15000	1	0.4	100.0
	228		

sites listed are individual body sites and others are cancer site groupings such as Site No. 1 (all sites) and Site No. 2 (all digestive). Individual and grouped body sites are apparent from their Manual of Tumor Nomenclature and Coding code numbers and their Eighth Revision International Classification of Diseases code numbers.

Table 2 presents the distribution of super tracts grouped into four intervals of asbestos. The table includes 410 super tracts instead of the original 427 because 17 super tracts with incomplete information were removed from the analysis. In general, the two lowest asbestos intervals contain the super tracts of the two counties east of the San Francisco Bay (Alameda and Contra Costa), and the two highest asbestos intervals contain the super tracts of the three counties west of San Francisco Bay (San Francisco, San Mateo, and Marin).

Tables 3-10 show the frequency distributions of population density by 1000 population per square kilometer for super tracts of the SMSA, West Bay and East Bay Counties, and San Francisco, San Mateo, Marin, Alameda, and Contra Costa Counties. For the SMSA, the majority of super tracts had populations per square kilometer of less than 5000. Of the 427 super tracts, 86% had less than 10,000 population/km². The mean population per square kilometer for the SMSA was 5391.38, with a standard deviation of 6044.29.

West Bay and East Bay frequency distributions (Tables 4 and 5, respectively) showed that the most dense super tracts—those above 15,000 population per square kilometer—were found in the West Bay Counties. The county frequency distri-

butions of population density (Tables 6-10) indicated that the West Bay area had one high-density county (San Francisco) and two low-density counties (San Mateo and Marin). The East Bay area had one moderately dense county (Alameda) and one low-density county (Contra Costa).

Table 11 presents the correlation coefficients of cancer with population density for the 35 cancer sites analyzed by sex for the white study population. For the males, of 31 cancer sites (4 of the listed sites are for female reproductive cancers), 15 had positive correlation coefficients and 16 had negative coefficients. Three of the 15 positive coefficients were significant ($p < 0.05$), whereas 10 of the 16 negative coefficients were significant. This may be a bit misleading, however. Note that Site No. 1 (all sites) is significantly and positively associated with population density. This is also true for Site No. 15 (all respiratory). Although in general it appeared that cancer was negatively associated with population density for males, closer scrutiny of this table indicated that a positive association existed between most major cancers and population density.

For females, the pattern is markedly different. Of 34 cancer sites (one of the 35 sites is for male reproductive cancer), 3 were positive and 31 were negative. None of the positive coefficients was significant, but 17 of the negative coefficients were significant. The major cancers (digestive, respiratory, breast, and female reproductive) were negative and significant. The correlation of asbestos with population density was 0.486.

The regression of cancer standard incidence ratios on asbestos, covariables, and population

Table 6. Frequency distribution of population density for 103 super tracts of San Francisco County, 1972.

Population/km ²	Frequency	Relative frequency, %	Cumulative frequency, %
0- 1000	2	1.9	1.9
1000- 2000	1	1.0	2.9
2000- 3000	2	1.9	4.8
3000- 4000	4	3.9	8.7
4000- 5000	6	5.8	14.5
5000- 6000	9	8.7	23.2
6000- 7000	4	3.9	27.1
7000- 8000	4	3.9	31.0
8000- 9000	11	10.7	41.7
9000-10000	6	5.8	47.5
10000-11000	8	7.8	55.3
11000-12000	7	6.8	62.1
12000-13000	7	6.8	68.9
13000-14000	3	2.9	71.8
14000-15000	4	3.9	75.7
15000-16000	3	2.9	78.6
16000-17000	1	1.0	79.6
17000-18000	1	1.0	80.6
18000-19000	3	2.9	83.5
19000-20000	2	1.9	85.4
20000-21000	1	1.0	86.4
21000-22000	0	0.0	86.4
22000-23000	2	1.9	88.3
23000-24000	2	1.9	90.2
24000-25000	0	0.0	90.2
25000-26000	3	2.9	93.1
26000-27000	1	1.0	94.1
27000-28000	0	0.0	94.1
28000-29000	2	1.9	96.0
29000-30000	0	0.0	96.0
30000-31000	0	0.0	96.0
31000-32000	0	0.0	96.0
32000-33000	1	1.0	97.0
33000-34000	1	1.0	98.0
34000-35000	0	0.0	98.0
35000-36000	0	0.0	98.0
36000-37000	0	0.0	98.0
37000-38000	1	1.0	99.0
38000-39000	0	0.0	99.0
39000-40000	1	1.0	100.0
	103		

density was performed with a natural logarithm transformation of the cancer standard incidence ratios. To avoid taking the natural logarithm of zero, which would result from super tracts with zero observed cancer cases of a particular site, a small constant (0.01) was added to the numerators and denominators of the standard incidence ratios.

Table 12 shows the cancer sites with significant ($p < 0.05$) positive asbestos regression coefficients. Also presented are the p values for these coeffi-

cients and the p values for population density coefficients associated with these equations. The p values are based on the t -test for the hypothesis that the population regression coefficients are zero.

For males, the significant cancer sites included Site No. 1 (all sites), most of the digestive and digestive-related cancers, prostate and lung small cell carcinoma. None of the population density coefficients for these equations was significant. For females, the significant cancer sites included

Table 7. Frequency distribution of population density for 72 super tracts of San Mateo County, 1972.

Population/km ²	Frequency	Relative frequency, %	Cumulative frequency, %
0-1000	16	22.2	22.2
1000-2000	9	12.5	34.7
2000-3000	17	23.6	58.3
3000-4000	20	27.8	86.1
4000-5000	7	9.7	95.8
5000-6000	1	1.4	97.2
6000-7000	1	1.4	98.6
7000-8000	1	1.4	100.0
	72		

Table 8. Frequency distribution of population density for 24 super tracts of Marin County, 1972.

Population/km ²	Frequency	Relative frequency, %	Cumulative frequency, %
0-1000	17	70.8	70.8
1000-2000	4	16.7	87.5
2000-3000	2	8.3	95.8
3000-4000	1	4.2	100.0
	24		

Table 9. Frequency distribution of population density for 166 super tracts of Alameda County, 1972.

Population/km ²	Frequency	Relative frequency, %	Cumulative frequency, %
0- 1000	22	13.3	13.3
1000- 2000	14	8.4	21.7
2000- 3000	27	16.3	38.0
3000- 4000	26	15.7	53.7
4000- 5000	28	16.9	70.6
5000- 6000	21	12.7	83.3
6000- 7000	15	9.0	92.3
7000- 8000	4	2.4	94.7
8000- 9000	3	1.8	96.5
9000-10000	3	1.8	98.3
10000-11000	0	0.0	98.3
11000-12000	1	0.6	98.9
12000-13000	1	0.6	99.5
13000-14000	0	0.0	99.5
14000-15000	1	0.6	100.0
	166		

Site No. 1 (all sites) most of the digestive and digestive-related cancers, respiratory and breast cancers. Site Nos. 1, 2, and 3 showed significant negative population density regression coefficients. This corresponds to the highly significant negative correlation coefficients for these sites.

Finally, Table 13 presents a comparison between the regression results of the original study and the reanalysis. The table shows cancer sites with significant ($p < 0.05$) positive asbestos regression coefficients in either study. The cancer sites that were found to have significant positive

regression coefficients in the original study were essentially the same ones found to be significant in the reanalysis. For males, the significant sites were the same in both analyses. For females, two extra sites were found in the reanalysis that were not significant in the original study. These were Site Nos. 3 (digestive tract) and 8 (rectum). For males, the levels of significance were almost identical between analyses. The presence of population density in the reanalysis appeared to slightly decrease the levels of significance of the asbestos coefficients in the equations for these sites. For

Table 10. Frequency distribution of population density for 62 super tracts of Contra Costa County, 1972.

Population/km ²	Frequency	Relative frequency, %	Cumulative frequency, %
0-1000	25	40.3	40.3
1000-2000	9	14.5	54.8
2000-3000	8	12.9	67.7
3000-4000	13	20.9	88.6
4000-5000	7	11.4	100.0
	62		

Table 11. Correlation coefficients of cancer by population density by site, sex for white population, San Francisco-Oakland SMSA, 1969-1974.

Site no.	Name	White male		White female	
		Correlation coefficient	<i>p</i> value ^a	Correlation coefficient	<i>p</i> value ^a
1	All sites	0.104	<0.025	-0.192	<0.0001
2	All digestive	0.051		-0.164	<0.001
3	Digestive tract	0.070		-0.216	<0.00001
4	Esophagus	0.038		0.056	
5	Stomach	0.113	<0.025	-0.043	
6	Small intestine	-0.033		-0.114	<0.025
7	Colon	0.073		-0.175	<0.001
8	Rectum	0.032		-0.099	<0.025
9	Digestive-related organs	0.052		-0.019	
10	Liver	0.018		-0.106	<0.025
11	Gallbladder	-0.039		-0.004	
12	Pancreas	-0.073		0.031	
13	Retroperitoneum	-0.085	<0.05	-0.035	
14	Digestive organ NOS ^b	-0.025		-0.063	
15	All respiratory	0.095	<0.05	-0.087	<0.05
16	Larynx	0.031		-0.078	
17	Trachea, bronchus, lung	0.079		-0.080	
18	Pleura	-0.048		0.044	
19	Mediastinum	0.063		-0.079	
20	Breast	-0.052		-0.180	<0.001
21	Female reproductive	—		-0.172	<0.001
22	Cervix uteri	—		-0.035	
23	Corpus uteri	—		-0.249	<0.00001
24	Ovary	—		-0.064	
25	Prostate	0.001		—	
26	Urinary	-0.113	<0.025	-0.137	<0.005
27	Kidney	-0.119	<0.025	-0.077	
28	Bladder	-0.149	<0.005	-0.122	<0.025
29	Brain	-0.142	<0.005	-0.137	<0.005
30	Thyroid	-0.094	<0.05	-0.038	
31	Hodgkin's disease	-0.103	<0.025	-0.112	<0.025
32	Leukemia	-0.107	<0.025	-0.033	
33	Lung small cell carcinoma	-0.099	<0.025	-0.113	<0.025
34	Lung squamous	0.072		-0.008	
35	Lung adenocarcinoma NOS ^b	-0.132	<0.005	-0.118	<0.01

^a*p*-value based on *t*-test for *H*: *r* = 0, *n* = 410.^bNot otherwise specified.

females, the coefficients were generally more significant with population density included in the analysis. In particular, Site Nos. 1 and 2 were much more significant in the reanalysis than in the original analysis.

Conclusions

The inclusion of population density in the analysis of ingested asbestos and cancer had little effect on the results. Therefore, the conclusion is

Table 12. Cancer sites with significant ($p < 0.05$), positive asbestos regression coefficients, associated population density significance, by sex, San Francisco-Oakland SMSA, 1969-1974.

Site no.	Race and sex	Name	Asbestos p value	Population density p value
	White male			
1	"	All sites	0.046	0.702 ^a
2	"	All digestive	0.001	0.764
3	"	Digestive tract	0.007	0.234
4	"	Esophagus	0.003	0.753 ^a
5	"	Stomach	0.008	0.151
7	"	Colon	0.021	0.632
9	"	Digestive-related organs	0.001	0.120 ^a
12	"	Pancreas	0.001	0.125 ^a
25	"	Prostate	0.039	0.686
33	"	Lung small cell carcinoma	0.015	0.067 ^a
	White female			
1	"	All sites	0.002	0.001 ^a
2	"	All digestive	0.001	0.001 ^a
3	"	Digestive tract	0.002	0.001 ^a
4	"	Esophagus	0.004	0.306 ^a
4	"	Stomach	0.001	0.178 ^a
8	"	Rectum	0.044	0.443 ^a
9	"	Digestive-related organs	0.004	0.648 ^a
12	"	Pancreas	0.002	0.463
13	"	Retroperitoneum	0.014	0.093 ^a
15	"	All respiratory	0.001	0.552
17	"	Trachea, bronchus, lung	0.001	0.384
18	"	Pleura	0.035	0.919
20	"	Breast	0.002	0.117 ^a

^aIndicates negative regression coefficient.

that a positive association between ingested asbestos and cancer existed in the San Francisco-Oakland SMSA for 1969-1974 for certain cancer sites. In spite of the persistent relationships across analyses, there are a number of warnings concerning the results and conclusions. The first is that the associations observed in these analyses are indirect, i.e., the units of observation were census tract groupings (super tracts), which means that groups of individuals were aggregated geographically and analyzed as groups. Therefore, the variables measured are applied to the groups. Individual measurements are not made, and the group measurements are assumed to apply to all members of an observational unit. Although the indirect method of analysis is an inexpensive design for a first look at an epidemiologic hypothesis, the underlying assumptions of the method make definitive conclusions untenable. In the asbestos-cancer analyses, the results indicate a possible direction for further research using other, direct method, designs. For instance, digestive cancers in both males and females were highly, significantly, positively associated with ingested asbestos. A case-control study or follow-

up study might investigate this particular association.

The second caution is that the number of cancers is small for a number of the body sites studied. For Site No. 1 (all sites), there were approximately 56,000 incidence cases for all ages and both sexes yielding about 130 cases per super tract. For site No. 6 (small intestine), there were fewer than 200 cases for both sexes. Therefore, there were fewer than 0.5 cases per super tract. In other words, there were a large number of super tracts with no cases of cancer of the small intestine. This makes any form of analysis much less powerful in terms of detecting an association.

Another warning about these results is that the 35 body sites analyzed were not independent. Some of the sites were individual body sites for cancer such as Site Nos. 4 (esophagus), 5 (stomach) and 6 (small intestine). Others were body site groupings such as Site Nos. 1 (all sites), 2 (all digestive) and 15 (all respiratory). The most meaningful results are found for the grouped body sites, since they include large numbers of cases and therefore avoid the aforementioned problem of too few cases per super tract. Unfortu-

Table 13. Comparison of significance ($p < 0.05$) for asbestos regression coefficients in 1969–1974 incidence study and reanalysis including population density, San Francisco–Oakland SMSA, 1969–1974.

Site no.	Race and Sex	Name	Original asbestos p value	Reanalysis asbestos p value
	White male			
1	"	All sites	0.05	0.046
2	"	All digestive	0.001	0.001
3	"	Digestive tract	0.002	0.007
4	"	Esophagus	0.003	0.003
5	"	Stomach	0.002	0.008
7	"	Colon	0.011	0.021
9	"	Digestive-related organs	0.001	0.001
12	"	Pancreas	0.001	0.001
25	"	Prostate	0.025	0.039
33	"	Lung small cell carcinoma	0.043	0.015
	White female			
1	"	All sites	0.048	0.002
2	"	All digestive	0.038	0.001
3	"	Digestive tract	—	0.002
4	"	Esophagus	0.007	0.004
5	"	Stomach	0.001	0.001
8	"	Rectum	—	0.044
9	"	Digestive-related organs	0.004	0.004
12	"	Pancreas	0.001	0.002
13	"	Retroperitoneum	0.036	0.014
15	"	All respiratory	0.001	0.001
17	"	Trachea, bronchus, lung	0.001	0.001
18	"	Pleura	0.027	0.035
20	"	Breast	0.005	0.002

nately, this does not allow identifying the exact location of the association of ingested asbestos and cancer in the body.

These findings in no way lend themselves to the interpretation regarding the possible regulation of asbestos in drinking water. Only research of the direct method design would allow for such conclusions. The recommendations from this research is that more investigation of a direct nature be done regarding digestive cancers and ingested asbestos. The scientific community will then be better equipped to answer questions about the possible regulation of asbestos in drinking water.

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Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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